EXPRESS MAIL NO. EV330379347US

METHOD AND APPARATUS FOR FORMING CONTAINER END SHELLS WITH REINFORCING RIB

BACKGROUND OF THE INVENTION

1. TECHNICAL FIELD

The invention relates to a method and apparatus for forming end shells for metal containers, and particularly to forming end shells having an annular reinforcing rib. Even more particularly, the invention relates to forming the reinforcing rib in the end shell in a single stroke and at a single station of a double action press.

2. BACKGROUND INFORMATION

In the metal container art, containers usually consist of a body formed of lightweight metal, such as aluminum, and a separate end shell for closing the container, also formed of lightweight metal, from strip material. It is desirable in forming the end shell to form a reinforcing rib at the junction of the chuckwall with the central panel of the shell to provide strength and rigidity to the end shell when secured to the container body. Heretofore, these reinforcing ribs were formed as annular grooves in the end panel, examples of which are shown in U.S. Patent Nos. 4,713,958, 4,715,208, 4,716,755, 4,808,052, 4,587,825, and 4,516,420. Although these types of reinforcing ribs have proven satisfactory, they provide an area in the can end which can collect impurities and other

materials. This is especially undesirable when the container has a removable tab which enables the contents to be drank directly from the container.

Another type of reinforcing rib, referred to as a rolled rib or folded rib, has been developed to replace the annular groove reinforcing rib. This reinforcing rib is formed in the metal end shell by collapsing or rolling a portion of an unclamped portion of an end shell chuckwall back upon itself during the formation of the end shell in a single action press. Although this type of rolled or folded reinforcing rib has proven satisfactory, it involves multiple operations and in particular, requires forming the folded rib at a first station or in a first press, and then final forming it in a second station or second press due to the partial unrolling or unfolding of the rolled rib after it has been formed at a first station due to the tendency of the metal in an unclamped portion thereof to return to its pre-stamped position.

Thus, the need exists for an apparatus and method for forming container end shells having a folded or rolled annular reinforcing rib in a single press cycle and at a single station, without having to complete the forming of the rib at a subsequent station, by eliminating the tendency of the stamped end shell including the rolled rib, to return to its pre-stamped condition.

BRIEF SUMMARY OF THE INVENTION

The present invention provides an apparatus and method for forming an end shell for use on a container body which is formed in a single press cycle at

a single work station of a double action press, wherein an unclamped portion of the chuckwall of the end shell, which extends between a central panel and peripheral flange, is folded or rolled upon itself to form a rolled reinforcing rib adjacent the junction of the central panel and chuckwall.

Another aspect of the present invention provides for the forming of an annular rolled reinforcing rib in the end shell without complicated and expensive modifications for retrofitting existing double action presses, and which eliminates the need for transfer mechanisms for the transferring of the end shell to an adjacent station or press for final formation of the reinforcing rib in the container end shell.

A further aspect of the invention provides an apparatus and method for forming the reinforcing rib in the end shell in which the punch core is fluidly mounted on an inner ram of the press, enabling the ram to continue in its cycle after the punch core has reached the bottom of its stroke for clamping the central panel of a disc blank against the die core, which enables the inner ram to time its return stroke to correspond to the start of the return stroke of the outer ram.

Another feature of the invention is providing inner and outer pressure sleeves which are movable by the outer ram for clamping engagement with an aligned inner die core ring, wherein said die core ring forms an annular void with the punch core in which the rolled reinforcing flange is formed during continued

movement of the inner and outer pressure sleeves after the punch core has bottomed out against the die core.

Still another feature of the invention is to provide the inner pressure sleeve with a curved surface against which an unclamped portion of the chuckwall of the partially formed end shell is engaged for curling or rolling the unclamped metal upon itself to form the rolled reinforcing rib.

A further feature of the invention is to provide for the simultaneous unclamping of the punch core and inner and outer pressure sleeves from the formed end shell by timing the cyclical movement of the inner and outer rams, to prevent distortion of the formed metal and in particular, prevent partial unrolling of the formed reinforcing rib.

The foregoing advantages, construction, and operation of the present invention will become more readily apparent from the following description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention, illustrative of the best mode in which applicant contemplates applying the principles, is set forth in the following description and is shown in the drawings and is particularly and distinctly pointed out and set forth in the appended claims.

Fig. 1 is a partially schematic sectional view of the apparatus of the present invention mounted in a press showing the position of the sheet metal at the start of the forming operation;

Fig. 2 is an enlarged view showing the position of the apparatus at the start of the forming operation;

Fig. 3 is an enlarged fragmentary sectional view similar to Fig. 1 showing the blanking of a disc blank from the sheet material at the start of the forming operation;

Fig. 3A is a further enlarged fragmentary sectional view of the encircled portion of Fig. 3;

Fig. 3B is a view similar to Fig. 3A showing the start of forming a chuckwall of an end shell blank;

Fig. 3C is a view similar to Figs. 3A and 3B showing the continued formation of the chuckwall of the end shell blank;

Fig. 4 is a sectional view showing the continued movement of the punch core and inner pressure sleeve from the position of Fig. 3 into clamping engagement with the end shell;

Fig. 4A is a further enlarged fragmentary sectional view of the encircled portion of Fig. 4;

Fib. 4B is a view similar to Fig. 4A showing the continued movement of the inner and outer pressure sleeves to start the folding of the un-clamped chuckwall portion into the reinforcing rib;

Fig. 5 is a view similar to Figs. 3 and 4 showing the punch core, and inner and outer rams at the end of their stroke completing formation of the reinforcing rib;

Fig. 5A is an enlarged fragmentary sectional view of the encircled portion of Fig. 5 showing the apparatus and end shell at the completion of the forming step;

Fig. 5B is a view similar to Fig. 5A showing the simultaneous disengagement of the punch core and inner and outer pressure sleeves from the formed container end shell;

Fig. 6 is a view similar to Figs. 3, 4, and 5 showing movement of the inner and outer rams and the position of the finished end shell prior to removal from the press;

Fig. 6A is an enlarged fragmentary sectional view of the encircled portion of Fig. 6;

Fig. 7 is a timing diagram of the inner and outer rams of the press; and

Fig. 8 is a fragmentary sectional view similar to Fig. 1 showing a knockout ring to assist in ejecting the end shell from the press.

Similar numerals refer to similar parts throughout the drawings.

DETAILED DESCRIPTION OF THE INVENTION

The method and apparatus of the present invention is utilized in conjunction with a double action press, some examples of which are shown and

described in U.S. Patent Nos. 3,902,348, 5,626,048, and 5,628,224. The main features of the press, which is indicated generally at 1 and shown in Fig. 1, are described briefly below, and include an inner ram 3 and an outer ram 5, only portions of which are shown in Fig. 1.

A punch core 7, also referred to as draw horn, is connected to the lower end of a punch riser 8, which is reciprocated by inner ram 3. In accordance with one of the features of the invention as shown in Fig. 1, riser 8 and punch core 7 are engaged with a fluid actuated piston 10, which is moved into engagement with punch riser 8 by compressed fluid located within a cylinder 12 formed within inner ram 3. The purpose of this arrangement is discussed further below.

An inner pressure sleeve 14 and a concentrically located outer pressure sleeve 15 surround punch core 7 and are reciprocated by outer ram 5 and independently move by a plurality of stacked cylinders 17. An outer punch shell 19 surrounds inner and outer pressure sleeves 14 and 15 and is secured to and movable with outer ram 5. A cut ring 20 is mounted on a retaining sleeve 21, which in turn is secured by a plurality of bolts 22 to a pedestal 23 mounted in a base 24.

A die core 26 is fixedly mounted with respect to base 24, and is surrounded by a movable die core ring 28, which is fluidly supported with respect to base 24. A lower pressure sleeve 30 is concentrically located outboard of die core ring 28, and is fluidly supported within a pressure cylinder 32 with respect to base 24.

The particular arrangement and features of the various elements of press 1 set forth above are standard components in the container end shell forming art, and thus, do not require extensive modification except for several unique features discussed further below.

In further accordance with the invention, a timing mechanism represented by the timing diagram of Fig. 7, controls the reciprocal movement or strokes of inner and outer rams 3 and 5 in a manner well known in the press art, and thus, is not described in detail except for the unique features of the timing cycle discussed further below achieved by the timing control system. In carrying out the method steps of the present invention, a strip of sheet material 34, such as lightweight aluminum, is fed into the press, as shown in Figs. 1 and 2. Outer ram 5 moves punch shell 19 downwardly in the direction of arrow A (Fig. 3) to sever a flat blank disc 36 from the sheet material without requiring any prior clamping pressure being applied to the sheet material. Blank 36 then is releasably clamped between outer pressure sleeve 15 and top surface 38 of die core ring 28.

As punch shell 19 and lower pressure sleeve 30 continue to be moved downwardly by outer ram 5 from the position of Fig. 3A to that of 3B in the direction of arrows B, an outer portion 36A of blank disc 36 is releasably clamped therebetween and will subsequently be removed therefrom, as shown in Fig. 3B. Continued downward movement of inner ram 3 will move punch core 7 in a downward direction shown by Arrow C in Figs. 3A and 3B. As punch core

7 moves toward die core 26, the metal in outer portion 36A of the disc blank, which is releasably clamped between outer pressure sleeve 15 and die core ring 28, moves therebetween to form a partially formed end shell 40. Shell 40 has a central panel 41, a chuckwall 42, and an outer flange 43. Inner ram 3 continues to advance punch core 7 toward base 24 by the use of the high pressure air in cylinder 12 as shown in Fig. 1, until it clamps central panel 41 against die core 26, as shown in Fig. 4A. In this position, outer flange 43 is clamped between outer pressure sleeve 15 and complementary shaped top surface 38 of die core ring 28.

As shown in Figs. 3C and 4A, an annular void or space 46 is formed between punch core 7 and die core ring 28 in which is located an unclamped portion 48 of chuckwall 42. As outer ram 5 continues downwardly, inner pressure sleeve 14 (Fig. 3A) will clampingly engage a chuckwall portion 49 against an angled surface 51 of the upper end of die core ring 28 adjacent the smooth generally curved surface 38 thereof. The lower end of inner pressure sleeve 14 (Fig. 3C) has a contoured surface indicated generally at 53, having an angled portion 54 and a concavely curved portion 55. Punch core 7 will bottom out and clamp central panel 41 of shell 40 against the top surface of die core 26 (Fig. 4A) and inner and outer pressure sleeves 14 and 15 continue to advance as shown by arrows D.

Referring to Fig. 4B the continued downward movement of outer ram, and in particular, inner and outer pressure sleeves 14 and 15 in the direction of

arrows D, moving with it the fluidly supported die core ring 28, as shown by arrow E, will cause the unclamped portion 48 of chuckwall 42, which is located in annular space 46, to move against concave surface portion 55 of inner pressure sleeve 14, causing the metal to start folding upon itself until it is completely rolled or folded on itself to form a reinforced rolled rib 60, as shown in Fig. 5A, upon pressure sleeves 14 and 15 reaching bottom-dead-center, as shown therein. During this movement, panel 41 is clamped tightly against die core 26 and portion 49 of chuckwall 42 is clamped tightly between inner pressure sleeve 14 and surface 51 of die core ring 28.

In accordance with one of the main features of the invention, the timing cycle of the inner and outer rams is controlled so that punch core 7, and inner and outer sleeves 14 and 15, retract or move away from their clampingly engaged position with die core 26 and die core ring 28 substantially simultaneously , as shown by arrows F in Fig. 5B. This prevents unequal metal distortion from being exerted on the formed end shell which is indicated generally at 62, and in particular on rib 60, which occurred in prior shell forming methods in which a rolled reinforcing rib was formed. Heretofore, in single action presses, the pressure sleeve would lift off before punch core 7, or visa versa, resulting in a partial unfolding of the rolled rib, which required the shell to be moved to a second station, either in the same press or in a different press, for final setting or formation of the rolled rib.

However, it has been found that in accordance with the invention, the simultaneous removal of nearly all clamping pressure during lift off, as shown in Fig. 5B, prevents partial unrolling of the just formed reinforcing rib 60 since even though the metal attempts to return to an unformed state, it moves equally in all directions since it is unrestrained by any clamping action thereon. If desired, punch core 7 could retract slightly before pressure sleeves 14 and 15 without substantially effecting the final set or formation of rib 60. After release and retraction of punch core 7 and inner and outer pressure sleeves 14 and 15, shell 62 is released from the press by a blast of pressurized air though passages 64 formed in base 24 (Fig. 6), or other lift mechanism, such as an annular lift or knockout ring 70 as shown in Fig. 8, to the position of Fig. 6A, where it then can be ejected from the press by a jet of pressurized air 65, or other known ejection mechanism or device.

In accordance with one of the features of the invention, and as represented in Fig. 7, is the timing sequence of the inner and outer rams. The inner ram leads the outer ram approximately 25° so that the inner ram clamps the central panel against the die core, as shown in Fig. 4A, as it reaches bottom-dead-center (BDC), whereupon the outer ram continues to move pressure sleeves 14 and 15 in a downward direction to form rolled rib 60 in the annular space 46, as shown in Fig. 4B. This movement is able to be achieved by the use of piston 10 and fluid cylinder 12, as shown in Fig. 1. This arrangement enables the punch core 7 to be moved initially along with inner ram 3, but upon

punch core 7 reaching bottom-dead-center as shown in Fig. 4, this fluid pressure arrangement provides for a dwell time of approximately 25° movement of the outer ram since inner ram 3 will continue its downward movement. However, punch core 7 remains stationary, with piston 10 moving upwardly through cylinder 12. This travel of piston 10 within cylinder 12 enables the inner ram to continue to move, but without affecting the clamping engagement of central panel 41 against die core 26. Therefore, as the outer ram reaches its bottom-dead-center, for example, 205° as shown in Fig. 7, inner ram 3 will still be at its bottom-dead-center, whereupon both the inner and outer rams will move upwardly at approximately the same instant of time to simultaneously remove the clamping engagement with the newly formed end shell, as shown in Fig. 5B, avoiding the partial unrolling of reinforcing rib 60. In the prior art formation of a rolled reinforcing rib in a single stage press, one of the pressure members will retract before the die core or visa versa resulting in one part of the shell remaining clamped, while the clamping pressure on another portion is relieved resulting in the partial unfolding of the rolled reinforcing rib.

The particular timing mechanism used for such presses is standard, and is easily calibrated to provide for any desired sequence of movement of the inner and outer ram, and thus, is not described in detail since the same is well known in the press art.

It furthermore understood from the above discussion that no thinning of the metal is required, but only the drawing and movement of the metal around

the die core ring and a portion of the unclamped chuckwall back upon itself to form the final end shell with the rolled reinforcement rib.

In the foregoing description, certain terms have been used for brevity, clearness, and understanding. No unnecessary limitations are to be implied therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes and are intended to be broadly construed.

Moreover, the description and illustration of the invention is an example and the invention is not limited to the exact details shown or described.